

**Part 1. Report Cover**

**Original Report Number:** 00AYP039

**Original Report Date:** 2 May 2000

**Title:** Performance Oriented Packaging Testing of a Commercial Grade V3c Fiberboard, Style RSC Box, 12 inches by 12 inches by 16 inches (ID), With 1-Gallon, Round, Glass Bottles, (Quantity of 1) for Liquids - Packing Groups I, II, and III (Surface Modes)

**Responsible Individual:** Francis S. Flynn

**Performing Activity:** LOGSA Packaging, Storage,  
and Containerization Center  
ATTN: AMXLS-T  
11 Hap Arnold Boulevard  
Tobyhanna, PA 18466-5097

**Performing Activity's Reference(s):** TE 35-97;  
AMC 13-88

**Retest Report Date(s):** N/A                      **Revision Date(s):** N/A

**Original Report Date:** 10 Sep 98

**Report Type:** Interim              Final

**DTIC Distribution:** N/A

**Requesting Organization:**

Defense Logistics Agency  
Defense Distribution Center  
ATTN: DDC-TO  
2001 Mission Drive  
New Cumberland, PA 17070

**Requesting Organization's Reference(s):**

1. DLA memorandum, 14 Oct 99

**Part 2. Test Results:** \_\_\_\_ single  X  combination \_\_\_\_ composite

### Section I. Pre-test Conditions

For initial testing, a bundle of boxes was received in new condition. Boxes from the lot from which this box was taken have also been performance tested with a variety of bottles and cans.

The following identification schema designates the packaging specimen used for the test(s) indicated. Assignments were made at random, in no particular order of sequence.

| <u>Specimen No.</u> | <u>Test</u>  |
|---------------------|--|
| 1                   | repetitive-shock vibration test<br>flat onto bottom, drop test<br>flat onto top, drop test<br>flat onto long side, drop test<br>flat onto short side, drop test<br>bottom joint corner (intended), drop test |
| 2                   | stack test   |
| 3                   | water resistance   |

### Section II. Summary

|  | <u>SPECIMEN</u> | <u>ALL</u>  |
|--|-----------------|-------------|
| <b>A. Drop test - 1.8 m (PG I SG 1.2, PG II SG 1.8, PG III SG 2.7)</b>           |                 | <b>PASS</b> |
| flat onto the bottom (face 3)  | PASS            |             |
| flat onto the top (face 1)   | PASS            |             |
| flat onto long side (face 4)   | PASS            |             |
| flat onto short side (face 6)  | PASS            |             |
| top corner (2-6-1)   | PASS            |             |
| <b>B. Stacking test - static load, 500 lb, 24 hr</b>                             |                 | <b>PASS</b> |
| <b>C. Vibration standard - repetitive-shock, rotary motion</b><br>3.53 Hz., 1 hr |                 | <b>PASS</b> |
| <b>D. Leakproofness test - restrained under water/soap over seams</b>            |                 | N/A         |
| production testing, 20 kPa, 5 min.   | N/A             |             |
| design qualification, 20 kPa, 5 min.   | N/A             |             |
| salvage drum requirement, 20 kPa, 5 min.   | N/A             |             |
| <b>E. Internal pressure test/Hydrostatic pressure test (liq.) -</b>              |                 | N/A         |
| <b>F. Water resistance test (fiberboard box) -</b>                               |                 | <b>PASS</b> |
| <b>G. Compatibility test (liq. in plastics) -</b>                                |                 | N/A         |

To be certifiable, the configuration must pass the applicable tests for the type packaging, intended lading, and mode(s) of shipment. This report ~~is~~/is not applicable to transportation by air.

**Part 2. Test Results** (continued)**Section III. Discussion**

Note. Numeric designations denote which specimen tested in that orientation.

**A. Drop test:** 49 CFR §178.603

- ☐ cold conditioned (0° F, 72 hr)  
☐ ambient conditions  
☒ standard conditions (50% RH & 23° C)

| No.            | Ht.   | Orientation                          | Results  |
|----------------|-------|--------------------------------------|--|
| 1 <sup>1</sup> | 1.8 m | Flat onto box bottom                 | Pass. No leaks/rupture; entire contents retained   |
| 1 <sup>1</sup> | 1.8 m | Flat onto box top                    | Pass. No leaks/rupture; entire contents retained   |
| 1 <sup>1</sup> | 1.8 m | Flat onto box long side              | Pass. No leaks/rupture; entire contents retained   |
| 1 <sup>1</sup> | 1.8 m | Flat onto box short side             | Pass. No leaks/rupture; entire contents retained   |
| 1 <sup>1</sup> | 1.8 m | Diagonally onto bottom, joint corner | Pass. No leaks/rupture; minor crushing of the 5-2-3 corner; bottle retained completely within the box; absorbent material had not settled. |

Note 1. Specimen 1, a combination packaging consisting of a grade V3c fiberboard box (outer packaging) containing an inner packaging (one 1-gal, round, glass bottle). The glass bottle was filled with water (SG 1.0) to 98% of maximum capacity (based on weight).

**B. Stacking test:** 49 CFR §178.606 (conducted under 00AYP040)

- ☐ Standard conditions (23° C & 50% RH)  
☒ Ambient conditions ( ~72° F )  
☐ High temperature conditions (104° F)

| No.            | Length | Type   | Load/Force | Peak Force | Results | Stability Maintained? |
|----------------|--------|--------|------------|------------|---------|-----------------------|
| 2 <sup>1</sup> | 24 hr  | Static | 500 lbf    | N/A lbf    | Pass    | Yes                   |

Note 1. Specimen 2, grade V3c fiberboard box, tested empty.

**C. Vibration test:** 49 CFR §178.608.

| No.            | Frequency | Duration | Results                              |
|----------------|-----------|----------|--------------------------------------|
| 1 <sup>1</sup> | 3.53 Hz   | 1 hr     | Pass. No leakage, rupture, or damage |

Note 1. Specimen 1, a combination packaging consisting of a grade V3c fiberboard box (outer packaging) containing an inner packaging one 1-gal, round, glass bottle. The glass bottle was filled with water (SG 1.0) to 98% of maximum capacity (based on weight).

**Part 2. Test Results: Section III (continued)**

**D. Leakproofness test:** 49 CFR §178.604

N/A. Leakproofness testing of inner packagings is not required.

**E. Internal Pressure/Hydrostatic Pressure test:** 49 CFR §178.605

N/A. Testing for the maintenance of internal pressure is not required for configurations intended for transportation by *surface modes*.

**F. Water resistance (Cobb Method) test** (fiberboard): As required by the standards for fiberboard boxes (49 CFR §178.516), the Cobb Method Test for water absorptiveness was performed on a specimen cut from one box (specimen 3) taken from the same bundle as the box used for rough handling (drop, stack, and vibration) testing.

No. specimens felt side (exterior) 5. Average 116.6 g/m<sup>2</sup>.  
Standard deviation 3.44. Highest exterior value was 120 g/m<sup>2</sup>.  
Lowest exterior value was 112 g/m<sup>2</sup>. All of the samples tested were free of printing.

No. specimens wire side (interior) 5. Average 127.4 g/m<sup>2</sup>.  
Standard deviation 9.53. Highest interior value was 144 g/m<sup>2</sup>.  
Lowest interior value was 120 g/m<sup>2</sup>.

No. specimens exceeding 155 g/m<sup>2</sup> 0.

It should be noted that improper storage and rough handling may break the fibers and abrade the coating of the box, decreasing its ability to resist water absorption. This could result in higher test values. Since commercial boxes are occasionally made with the wire facing (interior) as the exterior side of the box, specimens from both the wire (interior) and the felt (exterior) facings should be tested for water absorptiveness.

**G. Compatibility test** (plastics packagings only): N/A. The establishment of compatibility is a procedure specified in appendix B to part 173, as required by 49 CFR §173.24(e)(3)(ii), and is only required for *plastics packagings* intended to contain liquid hazardous materials.

**Part 2. Test Results (continued)**

**Section IV. Notes**

**The use of filament-reinforced tape as a means of banding, and as a secondary closure of the bottle, is required. This configuration is not applicable to the transportation of liquids by air.**

For this configuration, one of the following can be used without any notable difference in performance:

- 1) Fine grade vermiculite (CID-A-A-52450, Vermiculite, Absorbent (For Packaging Liquid Hazardous Materials))
- 2) HAZMATPAC® A-900
- 3) Absorbent Corporation Absorbent GP.

Note: Inner packagings have a tendency to migrate if the loose fill material is not firmly packed, especially into the box corners.

### **Part 3. Test Personnel**

- A. Drop test** (49 CFR §178.603)
- B. Stacking test** (49 CFR §178.606)
- C. Vibration standard** (49 CFR §178.608 and §173.24a(a)(5))
- D. Leakproofness test** (49 CFR §178.604) - N/A
- E. Internal pressure/Hydrostatic pressure test**  
(49 CFR §173.27 and §178.605) - N/A
- F. Water resistance standard** (49 CFR §178.516)
- G. Procedure for Testing Compatibility and Rate of Permeation  
in Plastic Packaging and Receptacles**  
(49 CFR §173.24, app B to part 173) - N/A

The personnel who performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein are recorded in the test files.

### **Part 4. References**

- A. Title 49 Code of Federal Regulations, Parts 173 and 178,**  
October 1, 1997 edition
- B. International Air Transport Association Dangerous Goods  
Regulations,** 39th edition, 1 January 1998
- C. ASTM D 4919,** Specification for Testing of Hazardous  
Materials Packagings
- D. ASTM D 999,** Standard Method for Vibration Testing of  
Shipping Containers
- E. ASTM D 951,** Standard Test Method Water Resistance of  
Shipping Containers by Spray Method
- F. TAPPI Standard: T 441** Water Absorptiveness of Sized (Non-  
Bibulous) Paper and Paperboard (Cobb Test)
- G. Recommendations on the Transport of Dangerous Goods,** sixth  
revised edition, United Nations, New York, 1990
- H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/  
MCO 4030.40A,** Packaging of Hazardous Material, 23 Jul 96

**Part 5. Equipment**

| <b>Item</b>                  | <b>Manufacturer</b>                        | <b>Serial<br/>No.</b> | <b>Calibration<br/>Expiration<br/>Date</b> |
|------------------------------|--|-----------------------|--|
| 6-inch dial calipers         | Brown & Sharp<br>Switzerland               | 599-5794              | 1/03                                       |
| 1,250-lb vibration table     | L.A.B<br>Skaneateles, NY                   | 8120179               | see note                                   |
| 4,000-lb vibration table     | Gaynes Engr. Co.<br>Franklin Park, IL      | G20765                | see note                                   |
| 12,000-lb vibration table    | M/RAD<br>Woburn, MA                        | 563-84                | see note                                   |
| 30,000-lb compression tester | Gaynes Engr. Co.<br>Franklin Park, IL      | G20950                | 4/00                                       |
| 5,000-lb compression tester  | L.A.B<br>Skaneateles, NY                   | 1107050               | 4/00                                       |
| 10,000-lb scale              | J.J. McIntyre & Sons<br>Whitehall, PA      | 5931A                 | 4/00                                       |
| 5,000-lb scale               | Fairbanks Scale<br>USA                     | H519240               | 4/00                                       |
| 500-lb scale                 | Toledo Scale<br>Worthington, OH            | N/A                   | 4/00                                       |
| 5,000-gram scale             | Ohaus Corporation<br>USA                   | 20078                 | N/A (new)                                  |
| 3,000-gram balance           | Brinkmann Instruments<br>Westbury, NY      | 3103120               | 4/00                                       |
| release hook                 | Gaynes Engr. Co.<br>Franklin Park, IL      | 18211-1               | N/R  |
| drop tester                  | L.A.B<br>Skaneateles, NY                   | 3811                  | N/R  |
| cold chamber                 | Russells<br>Holland, MI                    | 1962214               | 4/00                                       |
| altitude chamber             | American Research Corp.<br>Farmington, CT  | 5A13622               | 4/00                                       |
| 32-channel chart recorder    | Molytek, Inc.<br>Pittsburgh, PA            | 870403007-2S          | 7/00                                       |
| Cobb Sizing Tester           | Teledyne Curley<br>Troy, NY                | 4180-A                | N/R  |
| 30 psi pressure gauge        | WIKA Instrument Corp.<br>Lawrenceville, GA | 961420001             | 4/00                                       |
| 100 psi pressure gauge       | WIKA Instrument Corp.<br>Lawrenceville, GA | 961420002             | 4/00                                       |
| torque wrench (150 ft.-lb)   | Stanley-Proto<br>Covington, GA             | WWE30966              | 6/00                                       |
| torque wrench (100 ft.-lb)   | Stanley-Proto<br>Covington, GA             | WUK50305              | 7/00                                       |
| torque wrench (50 in.-lb)    | Stanley-Proto<br>Covington, GA             | 5A98                  | N/A (new)                                  |
| torque wrench (200 in.-lb)   | Stanley-Proto<br>Covington, GA             | WYC22958              | N/A (new)                                  |
| 400 kPa pressure gauge       | Ashcroft<br>Stratford, CT                  | 45323-016A            | 11/00                                      |
| 400 kPa pressure gauge       | Ashcroft<br>Stratford, CT                  | 5323-016B             | 11/00                                      |
| 100 kPa pressure gauge       | Ashcroft<br>Stratford, CT                  | 59694-011B            | 11/00                                      |
| 100 kPa pressure gauge       | Ashcroft<br>Stratford, CT                  | 59695-011A            | 11/00                                      |
| semi-automatic plastic pail  | Atlanta Grotnes                            | 44833                 | N/A  |
| Rieke® Flex Spout 600        |  | 15852                 | N/A  |

*Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.*

## Appendix A

### Test Applicability

Based on the drop height and computed stacking weight, this test report is applicable for all **surface** modes of transportation including road, rail, and water, when the liquid hazardous substance intended for containment by the tested packaging is in accordance with the equivalencies listed in appendix B, section III of this report.

**Transportation by air is not permitted** unless the bottle has been certified and marked as being air eligible at the required pressure for the hazardous item. Appropriate packaging paragraphs apply.

Pass/fail conclusions were based on the particular bottle and box specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed on the packagings. It was not possible to identify the exact composition of the box construction materials.

Testing was performed per Title 49 Code of Federal Regulations, subpart M of part II.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the



**Appendix A** (Continued)

actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous lading and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration which simply uses the performance tested box. Packaging paragraphs apply.

**Appendix B**

**Test Data Sheet**

**Section I. Test Product**

Name: Water

Physical State: ☐ solid ☒ liquid ☐ gas ☐ aerosol

Amount Per Container (Configuration):

1 gallon, rated

8.3 lb

11.5 lb, packed

Gross Weight: 28 lb (12.7 kg)

Density/Specific Gravity: 1.0

**Appendix B (Continued)****Section II. Test Parameters****Drop Height:** Ref: 49 CFR §178.603

|          |               |               |  |
|----------|---------------|---------------|--|
| _____    | 1.8 m;        | 71 in.        | (PG I, II, & III, SG 1.2 or solids)                  |
| _____    | 1.2 m;        | 47 in.        | (PG II & III, SG 1.2 or solids)                      |
| _____    | 0.8 m;        | 32 in.        | (PG III, SG 1.2 or solids)                           |
| <u>X</u> | <u>1.2 m;</u> | <u>71</u> in. | (other, PG <u>I</u> , SG <u>1.2</u> , and equivalent |
|          | from--        | <u>X</u>      | PG I: SG x 1.5 m, SG x 59.06 in.                     |
|          |               |               | 1.2 x 1.5 m, 1.2 x 59.06 in. ≈ 71 in.                |
|          | <u>X</u>      | PG II:        | SG x 1.0 m, SG x 39.37 in.                           |
|          |               |               | 1.8 x 1.0 m, 1.8 x 39.37 in. ≈ 71 in.                |
|          | <u>X</u>      | PG III:       | SG x 0.67 m, SG x 26.38 in.                          |
|          |               |               | 2.7 x 0.67 m, 2.7 x 26.38 in. ≈ 71 in.               |

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less. Equivalent specific gravity derived from drop height as follows--

PG factor x density (or SG) = drop height, thus  
 SG = drop height/PG factor (49 CFR §178.603)  
 0.67 m x SG = 1.8 m, thus SG = 2.7, PG III

**Internal Pressure/Hydrostatic Pressure (liquids only):** N/A

Ref: 49 CFR §178.605 and §173.27

**Appendix B (Continued)****Section II. Test Parameters (continued)****Stacking Weight Formula, Liquids - DLA**

| Variables                           | Inputs   | Calculations |
|-------------------------------------|----------|--------------|
| h height, drum/box                  | 16.5     |              |
| n # stacked containers              | XXXXXXXX | 7.2          |
| w1 weight, drum/box                 | 2.2      | 2.2          |
| w2 weight, bottle/can               | 11.5     | 11.5         |
| w3 weight, ring/pad                 | 0        | 0            |
| q1 # inner containers               | 1        | 1            |
| v1 max. volume, 1 inner container   | 1        | 1            |
| v total volume                      | XXXXXXXX | 1            |
| w4 weight, gross packaging          | 28       | 28           |
| W5 weight, absorbent                | 14       | 14           |
| W total weight                      | XXXXXXXX | 28           |
| C constant                          | 1        |              |
| A1 Stacking weight-PG I             | XXXXXXXX | <b>234.1</b> |
| A2 Stacking weight-PG II            | XXXXXXXX | <b>264.4</b> |
| A3 Stacking weight-PG III           | XXXXXXXX | <b>309.8</b> |
| A11 Stacking weight, rounded-PG I   | XXXXXXXX | <b>235</b>   |
| A21 Stacking weight, rounded-PG II  | XXXXXXXX | <b>265</b>   |
| A31 Stacking weight, rounded-PG III | XXXXXXXX | <b>310</b>   |

**NOTE:** A1 =  $(n-1) \cdot (w + (1.2 \cdot v \cdot 8.3 \cdot 0.98)) \cdot (c)$ , Packing Group I  
A2 =  $(n-1) \cdot (w + (1.8 \cdot v \cdot 8.3 \cdot 0.98)) \cdot (c)$ , Packing Group II  
A3 =  $(n-1) \cdot (w + (2.7 \cdot v \cdot 8.3 \cdot 0.98)) \cdot (c)$ , Packing Group III

A1 = stacking weight in pounds, PG I  
A2 = stacking weight in pounds, PG II  
A3 = stacking weight in pounds, PG III  
n =  $(118/h)$ , minimum number of containers that when stacked, reach a height of 3 m  
w =  $w1 + (w2 \cdot q1) + (w3 \cdot q1) \cdot w5$ , total weight in pounds  
v =  $v1 \cdot q1$ , total volume  
C = either 1.5 (the compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing), or 1.0 (static top load)

**Appendix B (Continued)****Section III. Equivalencies of Liquids**

|        | Specific<br>Gravity<br>see note 1 | Total (Each)<br>Amount per<br>Container | Gross Weight<br>(pounds) | Test Weight<br>(kilograms) |
|--------|-----------------------------------|---|--------------------------|----------------------------|
| water  | 1.0                               | 8.3 ( 8.3) lb                           | 27.5                     | 12.5                       |
| PG I   | 1.2                               | 9.9 ( 9.9) lb                           | 29.1                     | 13.2                       |
| PG II  | 1.8                               | 14.9 (14.9) lb                          | 34.1                     | 15.5                       |
| PG III | 2.7                               | 22.4 (22.4) lb                          | 41.6                     | 18.9                       |

Note 1. Equivalent specific gravity derived from drop height as follows-- PG factor x density (or SG) = drop height, thus

SG = drop height/PG factor (49 CFR §178.603)

PG I: 1.5 m x SG = 1.8 m, thus SG = 1.2

PG II: 1.0 m x SG = 1.8 m, thus SG = 1.8

PG III: 0.67 m x SG = 1.8 m, thus SG = 2.7

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less.

**Appendix C**

**Packaging Data Sheet**

**Section I. Exterior Shipping Container**

Packaging Category: \_\_\_\_ single X combination \_\_\_\_ composite

UN Type: Fiberboard boxes (49 CFR §178.516) UN Code: 4G

Specification Type(s):

- (1) Fabrication of Fiberboard Shipping Boxes
- (2) Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes
- (3) Box, Shipping, Fiberboard (canceled Mar 94)
- (4) Fiberboard: Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes (canceled Mar 94)

Specification Number(s):

- (1) ASTM D 5118, style RSC (regular slotted container)
- (2) ASTM D 4727 (marked), grade V3c (marked), type CF, variety SW, class (domestic/weather-resistant) not marked
- (3) Equivalent to-- PPP-B-636, style RSC [canceled Mar 94]
- (4) Equivalent to-- PPP-F-320E, type CF (corrugated fiberboard), variety SW (singlewall), grade V3c, class (domestic/weather-resistant) not marked, [canceled Mar 94]

Container Manufacturer:

Lynchburg Sheltered Industries Lynchburg Sheltered Industries  
Lynchburg, VA (boxmaker's seal) Lynchburg, VA 24501 (box flap)

Date of Manufacture: 4/97 (marked)

Manufacturer's Reference Number(s): N/A

Material: Corrugated fiberboard, glued manufacturer's joint

"bursting test 350 lbs per sq inch"

"min comb wt facings 180 lbs per sq in"

"size limit 100 inches"

"gross wt lt 120 lbs"

"min. avg. burst. stgth. in excess of \_\_\_\_ lbs. p.s.i." - N/A

NSN: 8115-00-418-4653

Tare Weight: 2 lb

Dimensions: 12 in. by 12 in. by 16 in. ID (marked)

**Appendix C** (Continued)

**Section I. Exterior Shipping Container** (continued)

Box Contract No.: Not marked

Box Purchase Order No.: Not marked

Closure Specification(s): ASTM D 1974, Methods of Closing,  
Sealing, and Reinforcing Fiberboard Shipping Containers

Closure Type: Pressure-sensitive, film-backed tape

Closure Type Specification(s):

- (1) Tested-- Commercial Item Description  
Tape, Film, Pressure-Sensitive Adhesive, (Box Closure)  
[canceled Dec 95]
- (2) Equivalent to-- FED SPEC  
Tape: Packaging, Waterproof [canceled Dec 95]
- (3) Equivalent to-- ASTM Specification for Pressure-Sensitive  
Tape for Packaging, Box Closure and Sealing

Closure Type Specification Number(s):

- (1) A-A-1830A (marked) [canceled Dec 95]
- (2) PPP-T-60, type III (film backing), class 2 (transparent)  
[canceled Dec 95]
- (3) ASTM D 5486, type I (waterproof, weather-resistant,  
polyester-backed), class 2 (transparent)

Closure Type NSN: 7510-00-266-6715

Closure Method: Tape applied over all seams, corners, and  
joints of the box. Tape applied to the manufacturer's joint  
shall cover the joint, but not extend beyond the corners. The  
tape applied to the seams shall be centered over the seams and  
shall extend over the corners and edges of the box a minimum  
of 2½ inches onto the adjacent box panels.

Closure Method Specification: ASTM D 1974 *sealing method B*;  
formerly method V, PPP-B-636 appendix (7-strip method)

Closure Dimensions: 2-inch (tape width)

Closure Manufacturer/Distributor:

|                            |                                   |
|----------------------------|-----------------------------------|
| American Tape              | SETAPE, INC.                      |
| Secaucus, NJ (core marked) | Jacksonville, FL (wrapper marked) |

Closure Contract No.: GS-141-63159 (box marked)

**Appendix C** (Continued)

**Section I. Exterior Shipping Container** (continued)

Closure Purchase Order No.: A-W-LE486-9E (box marked)

Closure Date of Manufacture: 2/97 (marked)

Reinforcement Type(s): Tape Banding

Reinforcement Specification(s) and Number(s): ASTM D 1974,  
Methods of Closing, Sealing, and Reinforcing Fiberboard  
Shipping Containers

Reinforcement Specification Method No(s): ASTM D 1974,  
modified Reinforcement Method 2B (see Reinforcement Method)

Reinforcement Method(s): Tape applied 1 inch from each end of  
the box. Bands shall overlap onto themselves at least  
3 inches. Modifications-- 1-inch-wide tape used instead of  
¾-inch-wide tape; four bands instead of one band; medium  
tensile tape used instead of high tensile tape

Banding Specification Type(s):

- (1) Tested (marked)-- Commercial Item Description  
Tape, Pressure-Sensitive Adhesive, (Medium Tensile  
Strength, Glass Filament, Reinforced Tape)  
[canceled Jan 96]
- (2) Equivalent to-- FED SPEC  
Tape, Packaging/Industrial, Filament Reinforced  
[canceled Jan 96]
- (3) Equivalent to-- ASTM Standard Specification for  
Pressure-Sensitive Tape for Packaging,  
Filament-Reinforced

Banding Specification Number(s):

- (1) A-A-1687B, Amendment 1 (marked) [canceled Jan 96]
- (2) PPP-T-97, type II (medium tensile),  
class B (transparent) [canceled Jan 96]
- (3) ASTM D 5330-93, type II (medium tensile)

Banding NSN: 7510-00-582-4772



**Appendix C** (Continued)

**Section I. Exterior Shipping Container** (continued)

Banding Position(s): See Additional Description

- 2 girthwise tape bands, *encircling top, bottom, and sides*,  
1 inch in from each end
- 2 lengthwise tape bands, *encircling top, bottom, and ends*,  
1 inches in from each side
- 0 horizontal tape bands, *encircling sides and ends*,  
centered around the box body

Banding Dimensions: 1 inch wide

Banding Manufacturer(s): RJM MFG./TARA TAPE (box marked)  
TARA TAPE (wrapper marked)  
Fairless Hills, PA 19030

Banding Contract No.: TC-GS-14F-63238

Banding Purchase Order No.: A-W-LC337-5E

Banding Date of Manufacture: 12/96 (box marked)

Cushioning/Dunnage: absorbent material [approx. 14 lb]

Cushioning/Dunnage Specification Type(s):

- Note. Recommended use-- Commercial Item Description,  
Absorbent material (For Packaging Liquid Hazardous Material)
- Fiberboard-- Standard Specification for Corrugated and Solid Fiberboard  
Sheet Stock (Container Grade) and Cut Shapes

Cushioning/Dunnage Specification Number(s):

- Recommended use-- A-A-52450, NSN: 8135-01-324-2664
- Fiberboard-- ASTM D 4727, type CF (corrugated fiberboard)  
variety SW (singlewall), C flute, class WR (weather-resistant) grade V3c

Cushioning/Dunnage Dimensions: see Additional Description

- Absorbent material-- Grade 3, ASTM C 516

Cushioning/Dunnage Manufacturer(s):

- Cellulose fiber-- HAZMATPAC®

**Appendix C (Continued)**

**Section I. Exterior Shipping Container (continued)**

Static Electricity Protection: To be determined

Additional Description:

a. More than one inch (1¼ in.) of loose-fill absorbent material was placed in the bottom of the box. The bottle was placed on the absorbent material, and more loose-fill absorbent material was then packed around and over the bottle. More than one inch (1¼ in.) of loose-fill absorbent material covered the bottle. Three inches of loose-fill absorbent material separated the bottle from the sides and ends of the box. **The loose-fill absorbent material must be firmly packed into the box corners.**

b. Before closing, the box was "shaken down" to settle the absorbent material. Additional absorbent material was added, as necessary to make a tight pack.

c. The quantities of absorbent material DO NOT meet the 1-gallon guidelines for absorbent material (2.5 in. top/bottom, 1.5 in. sides) outlined in AFJMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19F/DLAM 4145.3, Preparing Hazardous Materials for Military Air Shipments.

d. When used, care must be exercised when selecting absorbent material to avoid introducing water or surfactants (treatments to reduce dust) into the package. Only untreated absorbent material should be used.

e. Before cancellation, PPP-B-636 specified that *horizontal* reinforcing tape bands (*encircling the box sides and ends*), are not required when the box depth (height) is less than but not equal to 18 inches. Experience has demonstrated that glued manufacturers' joints have potential to fail if horizontal reinforcing tape banding is not applied.

f. Before cancellation, PPP-B-636 specified that one *girthwise* reinforcing tape band (*encircling the box top, bottom, and sides*), is required when the box length is less than but not equal to 20 inches. Two reinforcing tape bands in the girthwise direction were used per instructions from the requesting organization.

**Appendix C** (Continued)**Section I. Exterior Shipping Container** (continued)

g. Before cancellation, PPP-B-636 specified that one *lengthwise* reinforcing tape band (*encircling the box top, bottom, and ends*), is required when the box width is greater than 9 inches and less than 18 inches. Two reinforcing tape bands in the lengthwise direction were used per instructions from the requesting organization.

h. ASTM D 1974 recommends that, when used, tape bands shall be placed around the girth (smallest circumference) of the box with at least one band for each 15 inches of box length.

i. Prior to 3 March 1994, PPP-B-636 specified the construction, closing, and reinforcing of fiberboard boxes, while PPP-F-320 specified the fiberboard. Both FED SPECs have been canceled and replaced with ASTM documents. ASTM D 4727 is the specification for fiberboard; ASTM D 5118 is the practice for fabricating fiberboard boxes; and ASTM D 1974 is the practice for closing, sealing, and reinforcing fiberboard boxes. The three ASTM documents almost mirror the two FED SPECs with the most notable exception being that PPP-B-636 provided tables for when and what size reinforcement was to be specified. ASTM D 1974 does not recommend comparable reinforcements.

**Appendix C (Continued)**

**Section II. Inner Packaging of Combination Packaging  
Applicable/~~Not applicable~~**

Quantity of Inner Containers: 1

Capacity: 1 gallon each; 3.78 liters (marked)

Specification Type and No(s): N/A

NSN: N/A

Type: Round, brown glass, screw-cap bottle with handle

Manufacturer/Distributor: Embossed on the bottom as follows--  
7 I 74  
encircled

Material(s): Brown glass Date(s) of Manufacture: N/A

Tare Weight (empty bottle): 3.2 lb Filled Weight: 11.5 lb ea

Dimensions: 13¾ in. high; 6 in. diameter

Closure (Method/Type): Plastic screw cap, polyseal-24

Closure Specification Number(s): N/A

Closure Manufacturer: N/A

Closure Dimensions: 1-5/8 in. in diameter (OD)  
½ in. in height (OD)

Secondary Closure: Filament-reinforced tape (1 pc)

Secondary Closure Specification(s):

- (1) Tested (marked)-- Commercial Item Description  
Tape, Pressure-Sensitive Adhesive, (Medium Tensile  
Strength, Glass Filament, Reinforced Tape)  
[canceled Jan 96]
- (2) Equivalent to-- FED SPEC  
Tape, Packaging/Industrial, Filament Reinforced  
[canceled Jan 96]
- (3) Equivalent to-- ASTM Standard Specification for  
Pressure-Sensitive Tape for Packaging, Filament-Reinforced

**Appendix C** (Continued)

**Section II. Inner Packaging** (continued)

Secondary Closure Specification Number(s): NSN-- 7510-00-582-4772

- (1) A-A-1687B, Amendment 1 (marked) [canceled Jan 96]
- (2) PPP-T-97, type II (medium tensile),  
class B (transparent) [canceled Jan 96]
- (3) ASTM D 5330-93, type II (medium tensile)

Secondary Closure Dimensions: 1 inch wide

Secondary Closure Manufacturer(s):

RJM MFG./TARA TAPE (box marked)  
TARA TAPE (wrapper marked)  
Fairless Hills, PA 19030

Secondary Closure Contract No.: TC-GS-14F-63238

Secondary Closure Purchase Order No.: A-W-LC337-5E

Secondary Closure Date of Manufacture: 12/96 (box marked)

Cushioning/Dunnage Type: None

Cushioning/Dunnage Specification Type and Number(s): N/A

Cushioning/Dunnage Dimensions: N/A

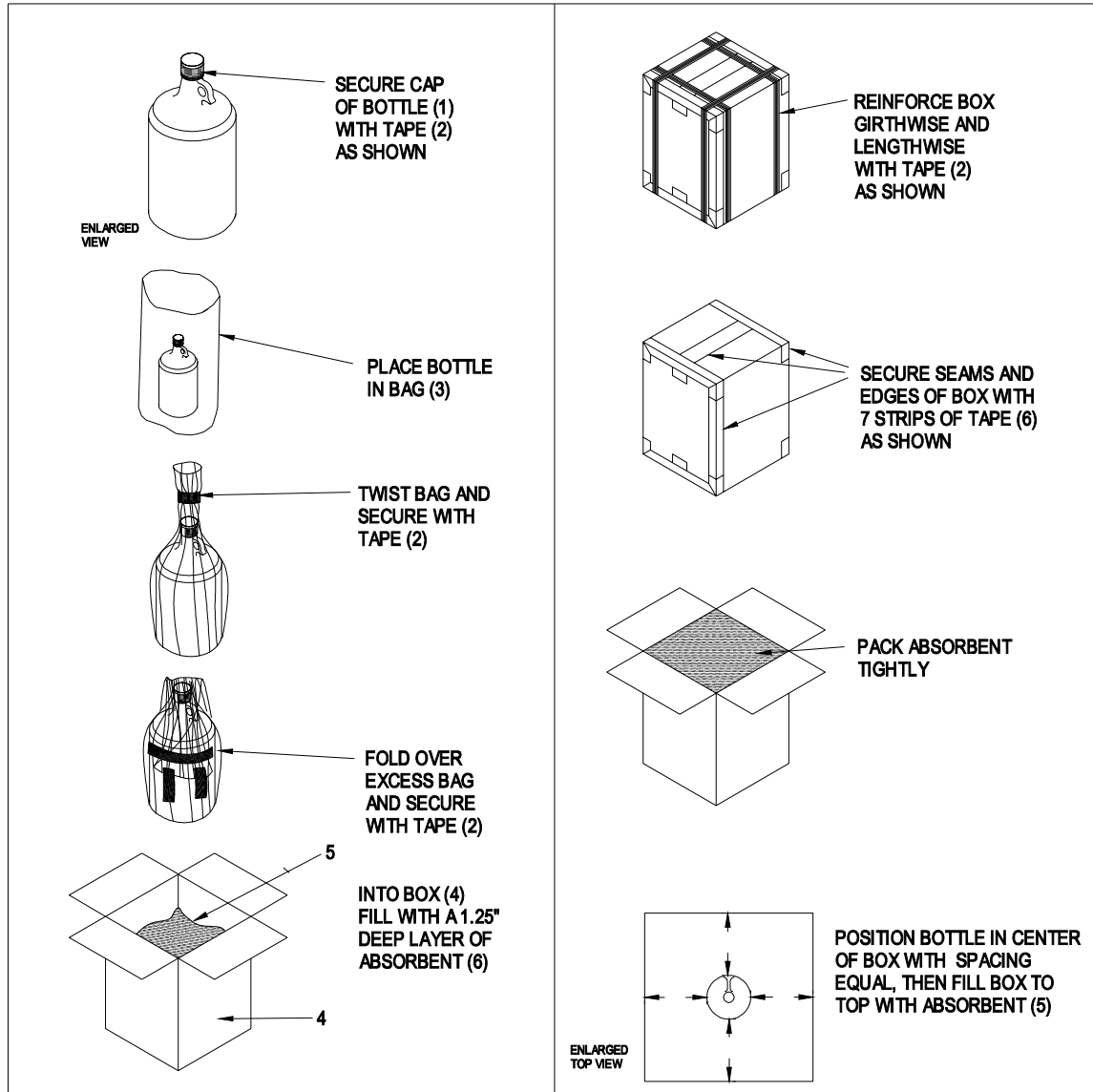
Cushioning/Dunnage Manufacturer: N/A

Static Electricity Protection: N/A

Additional Description: N/A

**Appendix C (Continued)**  
**Section III. Drawing**

RN: 00AYP039



| ITEM | DESCRIPTION   | 0AYP039D |
|------|---|----------|
| 1    | 1 GAL., GLASS, ROUND, SCREW CAP BOTTLE WITH HANDLE, QTY. 1                            |          |
| 2    | 1-INCH WIDE, PRESSURE-SENSITIVE TAPE, FILAMENT-REINFORCED, IAW ASTM D5330, TY II      |          |
| 3    | PLASTIC BAG, 4-MIL POLYETHYLENE   |          |
| 4    | FIBERBOARD BOX, ASTM D5118, STYLE RSC, GRADE V3c, NSN: 8115-00-418-4653, 12X12X16 IN. |          |
| 5    | CELLULOSE FIBER ABSORBENT, OR VERMICULITE, A-A-52450                                  |          |
| 6    | 2-INCH WIDE, PRESSURE-SENSITIVE TAPE, IAW ASTM D 5486, TY II, NSN: 7510-00-266-6715   |          |
|      |   |          |

## Appendix D

### Rationale

The equivalent of Packing Group I (great danger) testing was requested for a 12- by 12- by 16-inch corrugated fiberboard box having as the intended contents one 1-gallon, round glass bottle, with screw cap. The configuration to be tested is intended to be applicable to a large assortment of liquid products contained in screw-cap, round, glass bottles, in volumes of 1-gallon, ½-gallon, 1 quart, 1-pint, or less. For lesser volumes, variations to testing requirements can be found in 49 CFR §178.601(g).

For testing, substitution for the actual hazardous lading is permitted by 49 CFR §178.602(c). Water can be used as a substitute liquid.

A plastic bag, tightly folded, and securely taped, was used as a leakproof liner.

A bottle secondary closure utilizing filament reinforced tape was used in accordance with accepted packaging practice.

One combination packaging made to the above described configuration was subjected to drop and vibration testing as prescribed in ASTM D 4919. These tests are designed to simulate the shock and vibration a package (configuration) may encounter when being shipped worldwide by truck, rail, or ocean going transport. The order of testing was vibration, then drop testing. Prior to the rough handling testing of the packed box, static loading was performed on the empty box. This is a U.S. DOT approved method of stack testing, especially when the combination packaging has wide applications. Two additional boxes were used for water absorptiveness testing of the fiberboard.

In conducting the drop test, all five drops (flat bottom, flat top, flat long side, flat short side, and top corner) were performed on the same configuration. The decision to use the same container (configuration) for all five drop orientations was based on the relatively minimal damage demonstrated during previous testing of grade V3c, class weather-resistant, corrugated fiberboard boxes with different inner containers. It should be noted that five drops per box exceeds 49 CFR requirements. One drop per box orientation is the **minimum** per 49 CFR requirements (49 CFR §178.603(a)), as well as, per both UN and ASTM recommendations (i.e., one drop on a side or corner per box). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

**Appendix D (Continued)**

Due to the variety of items to be packaged, testing was actually conducted according to the parameters for dense liquids (those with specific gravity up to 1.8) belonging to Packing Group II. This would equate to rough handling tests equivalent to those for Packing Group I for liquids having a specific gravity of 1.2 or less, and for Packing Group III liquids having specific gravity 2.7 or less.

For the drop test (49 CFR §178.603), a free fall drop table, set for 1.8 meters (71 in.), was used. The impact surface was the ½-inch steel impact plate of the table, which was bolted to the concrete floor.

For the stack test (49 CFR §178.606), a 500-lb steel plate was used as a static top load, because it could hold the load constant for the required 24-hour timeframe. The minimum total top load to be applied was computed based on the density of the heaviest liquid anticipated at 98% of maximum capacity, and the outer box height. The top load was to simulate a stack of identical packagings which might be stacked on the packaging during transport. The minimum height of the stack could not be less than 3 meters (118 in.), so the number of packagings (stack height minimum divided by assembled box height) had to be represented by an integer number, which had to be rounded up, without respect to which was the nearest whole number.

The leakproofness of the glass bottle is not required, because the bottle is an inner packaging in a combination packaging.

The hydrostatic pressure test (49 CFR §178.605) is a test to be performed for single packagings, and is not required for inner packagings of combination packagings. For internal pressure requirements for inner packagings of combination packagings intended for transportation by aircraft, 49 CFR §173.27(c) applies. For combination packagings to be transported by air, if the inner packaging is not able to maintain the designated internal pressure (49 CFR §173.27(c)(3)(i)), the inner packagings may be packed in a supplementary packaging which does meet the pressure requirements. The assumption was that the inner containers (glass bottle) would not maintain the minimum internal pressure of 95 kPa (14 psi) stipulated for liquids other than Packing Group III in Class 3 or Division 6.1 (49 CFR §173.27(c)(2)(i)), for which a minimum internal pressure of 75 kPa (11 psi) is required. Therefore, for transportation by aircraft, the configuration, as tested, would need to be overpacked in a supplemental packaging (e.g., a drum) which *must be capable of* withstanding without leakage an internal pressure as caused by changes



**Appendix D (Continued)**

in altitude and temperature during transportation aboard aircraft. To determine if the supplemental packaging is capable of maintaining the required pressure for the intended lading, the liquid contents need to be identified along with the associated vapor pressure at 50° C or 55° C. As the configuration being tested is a combination packaging, it is not subject to the single packaging hydrostatic pressure test (49 CFR §178.605) and marking requirements of 49 CFR §178.503(a)(5). More clearly stated, a hydrostatic pressure test of 250 kPa (36 psi) for liquids in Packing Group I is not applicable, unless 250 kPa is the pressure related to the vapor pressure of the liquid to be conveyed, as computed based on the vapor pressure of the lading at 50° C or 55° C.

As required by the standards for fiberboard boxes (49 CFR §178.516), the Cobb Method Test for water absorptiveness was performed using five specimens cut from the exterior side, and five specimens cut from the interior side of two boxes taken from the same bundle as the box used for rough handling (drop, stack, and vibration) testing. This test was performed per TAPPI Method T 441. The apparatus used was a commercially available Cobb Sizing Tester. The volume of deionized water was computed to maintain an equivalent head of  $1.0 \pm 0.1$  centimeter. Since boxes are occasionally made with the wire facing (interior) as the exterior side of the box, specimens from both the wire (interior) and the felt (exterior) facings should be tested for water absorptiveness. It should be noted that improper storage and rough handling can break the fibers and abrade the coating, decreasing the ability to resist water absorption. This could result in higher test values.

The vibration test (49 CFR §178.608), utilizing a 1,250-lb capacity vibration table, was performed to be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (49 CFR §173.24a(a)(5)). The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). Testing was conducted as a means to determine capability. The test was run for 1 hour.

Compatibility testing (a procedure specified in appendix B to part 173, as required by 49 CFR §173.24(e)(3)(ii)) is only required for *plastics* packagings intended to contain liquid hazardous materials.

